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## NASA SimLabs News

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#### Welcome New Subscribers!

If you are receiving this newsletter for the first time, SimLabs News is a quarterly publication reviewing current projects at the NASA Ames Simulation Laboratories (SimLabs). NASA [SimLabs](#) is comprised of three unique Flight Simulators, an Air Traffic Control radar simulator and a high fidelity Air Traffic Control Tower simulator. The facilities support government as well as private industry in a wide array of applications. To find out more, read on!

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### 1. Learning Ways to Counter Pilot Fatigue on Ultra-long Flights

Have you ever wondered how pilots manage to stay alert on those ultra-long oceanic flights? While you get some sleep if you're lucky, what's going on in the cockpit to make sure your pilots stay fully alert? At the end of the long flight, how do they manage the high workload of a safe descent and landing while you drag yourself off the plane exhausted?

That's what SimLabs is helping the [Ames Fatigue Countermeasures Group](#) learn through a study entitled "Effects of Ultra-long Range Flights on Pilot Performance." In the SimLabs' [Crew-Vehicle System Research Facility \(CVSRF\)](#) Boeing 747-400 simulator, researchers are safely evaluating different in-flight sleep scheduling strategies to improve alertness and performance during ultra-long range commercial flights of 20 hours or more. [SimLabs' B747-400 Simulator Flight Deck](#)

In the first phase of the study, two-person flight crews are considered to be on a 3-day line-trip where duty regulations are adhered to in real time. On Day One of the study, the pilots fly two baseline flights, LAX to SFO and SFO to LAX.



SimLabs B747-400 Simulator Flight Deck

Day Two consists of a 20-hr flight from Los Angeles to Singapore. Some of the subjects will depart during simulated daytime, and others during the nighttime. The pilots are monitored during the 20-hr flight for physiological alertness, performance changes, and subjective mood ratings. The 747-400 simulator collects aircraft state data, flight plan and flight deck audio and visual recordings. Phase One will conclude in February. Results are pending analysis of the data.

In the second phase, four-person crews will be studied. A total of 60 Airline Transport Pilot (ATP) certified pilots will complete 20 of the 20-hour flights in the simulator during both phases of the study. This research is funded by NASA's Human Measures and Performance Program.

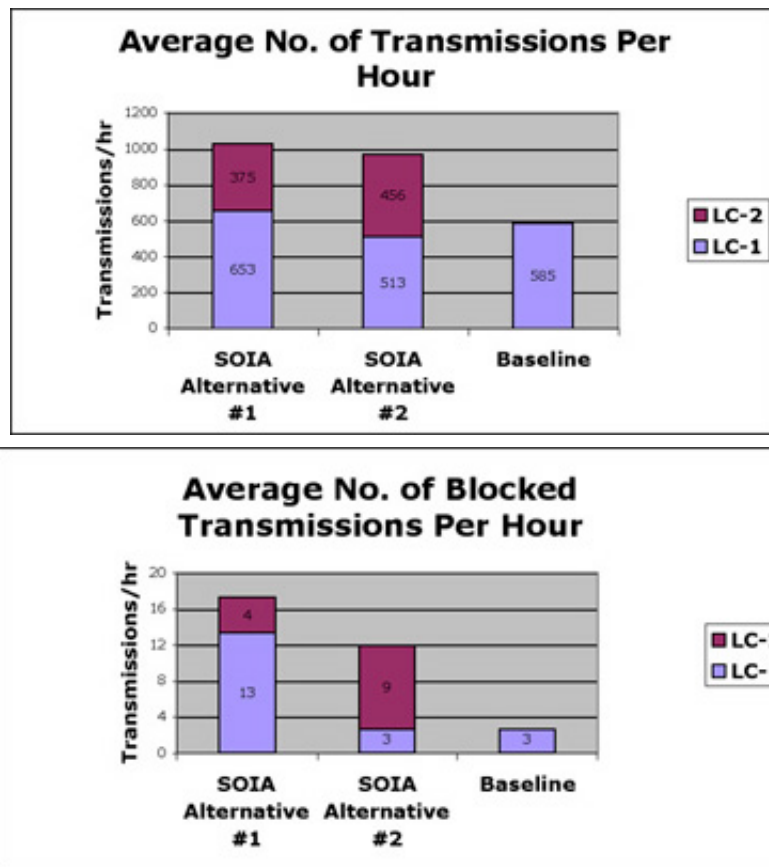
## 2. Airport Frequency Congestion and Controller Workload

Voice communications is one of the most demanding aspects of air traffic control, especially in the nation's busiest airport towers. For example, at DFW, well over 2000 transmissions take place every hour between the controllers and pilots. Analysis of speech rates shows that during busy times, some controllers are transmitting over 50% of the time at rates exceeding 4 words per second.

An important consideration in the design of airport changes should be how they will impact controller communications. As an example, a summer university intern conducted an independent study in FutureFlight Central on the communication workload dimension of a new procedure for San Francisco International Airport called Simultaneous Offset Instrument Approach (SOIA). SOIA can be used at airports like SFO that have runway spacing less than 3000 ft but at least 750 ft apart, to conduct simultaneous approaches to increase the arrival rates in marginal weather conditions.

Under the SOIA procedure, controllers are expected to experience an increase in frequency congestion due to three factors: 1) additional speed and other advisories conveyed to pilots to maintain the required staggered spacing during the final approach, 2) a longer approach zone over which tower controllers monitor the approach control frequencies, and 3) increased coordination between control positions within the tower.

The study compared two potential implementations for the SOIA procedure with the normal paired visual approach. Four types of data were collected on the controller subjects during simulation runs in FutureFlight Central: radio frequency utilization, physiological response, subjective opinion, and quantitative measurement of airport surface efficiency. Analysis of voice recordings taken during the simulation measured the increase in radio frequency utilization over the baseline including blocked transmissions (simultaneous transmissions requiring repeat). Frequency saturation can degrade safety through the increased likelihood of blocked transmissions, rushed clearances and read backs, or the inability for pilots and controllers to immediately communicate urgent information or instructions.



Technologies and procedures to increase airport capacity and safety are in continuous development to meet the demands of the future. Real-time interactive simulation is a powerful tool to include human performance considerations. Evaluation of concepts early on with the human in mind, promotes both the safety of they flying public and efficient use of taxpayer dollars.

### 3. SimLabs Helps Army's CH-47 Adapt to Its Changing Role

Boeing developed the CH-47 (Chinook), a heavy-lift transport helicopter for the U.S. Army. Initially designed for movement of troops and supplies, and heavy construction, the helicopter's duties have changed in recent years, emphasizing night and low altitude nap-of-the-earth flight. With the changing missions, the aircraft's handling qualities were no longer appropriate for optimal mission performance and safety.

The current fleet was designed with 60's to

70's flight control system technology. The hydro-mechanical systems are complex but limited in capability. Modern flight control laws will improve the mission performance and safety, but the vehicle will need a digital flight control system.

SimLabs' [Vertical Motion Simulator \(VMS\)](#) recently simulated a new digital automated flight control system (DAFCS) for the CH-47F version. The project was a joint Army/Boeing effort with the Army represented by the Army Flight Dynamics Directorate (AFDD). The purpose was to evaluate the DAFCS handling qualities and provide recommendations for improvements. Evaluations were performed in "day" and "degraded visual environments" using a series of tasks from the Aeronautical Design Specifications (ADS-33).



CH-47 Chinook Helicopter

Boeing provided the CH-47F vehicle model and control laws. Army personnel provided the control law analysis and optimization. The VMS staff integrated all the components, and pilots compared the new DAFCS with the standard analog AFCS currently used on the CH-47D. During the course of the study, the Army generated an optimized alternative set of parameters that SimLabs also evaluated for inclusion in the flight test program.

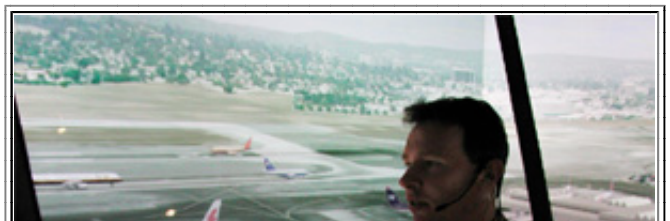
In general, the pilots felt the new control laws were an improvement and that the optimized control laws provided by AFDD was an even better improvement.

#### 4. Simulation to Play a Major Role in Air Traffic Controller Staffing Plan

The Federal Aviation Administration (FAA) recently released a [ten-year plan](#) to address the expected wave of air traffic controller retirements. Of notable interest is the intention to expand the use of high-technology simulators to improve and compress the training process. The FAA believes training can be reduced from 3-5 years to 2-3 years through the use of high fidelity simulators and other efficiencies.

Those of us in the simulation world say, "It's about time!" Simulation has been successfully employed for decades as a cost-effective part of pilot initial and recurrent training. The benefits for air traffic controllers will be numerous: the ability to exercise emergency response procedures; exposure to a wider array of conditions in shorter period of time; elimination of training-induced accidents and delays; flexibility to stop, discuss, and replay scenarios; training tailored to individual progress; and reduced time for on-the-job training resulting in reduced overall cost.

Now the question is how much will it cost and how long will it take to get a program going? Here's where NASA hopes to lend the FAA a helping hand. Existing ATC simulation facilities such as NASA SimLabs are a ready resource for the FAA to conduct a trial program. What





could be more cost-effective than utilizing these existing investments in a pilot program?

New controllers, accustomed to simulation in College Initiative Training (CIT) schools or FAA academy programs, should adapt easily to the new FAA plan. Controllers transitioning to new facilities or with career gaps, will welcome simulator training as a way to come up to speed quickly.



Air Traffic Controller in FutureFlight Central

Simulation cannot completely substitute for on-the-job training, but it can come pretty close. Certified controllers from LAX, SFO and DFW who have participated in research studies in SimLabs' [FutureFlight Central](#) tower, have remarked that the realism provides the same heightened state of awareness as working live traffic.

## 5. Thinking of Doing Business with NASA SimLabs?

For more information on what we can do for your needs, contact:

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